

# INTERSEXUALITY AND GYNANDROMORPHISM IN GAGRELLID HARVESTMEN (PALPATORES, OPILIONES, ARACHNIDA)

By

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## Synopsis

TSURUSAKI, Nobuo (Zoological Institute, Faculty of Science, Hokkaido University, Sapporo 060, Japan): Intersexuality and gynandromorphism in gagrellid harvestmen (Palpatores, Opiliones, Arachnida). *Acta arachnol.*, 31: 7-16 (1982).

Two sexually anomalous individuals of the gagrellid harvestmen are described. Of these, one case found in *Gagrellula montana* SATO et SUZUKI exhibited perfect intersexuality; the reproductive system consisted of imperfectly developed ovary, a long duct which probably corresponds to sperm reservoir and propulsion organ, and genitalia showing a condition intermediate between those of both sexes. The other case in *Melanopa grandis* ROEWER was a partial gynandromorph with preponderance of female characters. The reproductive system was of the normal female except for somewhat malformed ovipositor.

The male and female genitalia of *G. montana* are first illustrated.

Up to the present, about twenty individuals of harvestmen have been described as the cases of intersexuality in the literature (BLANC 1880, BŁASZAK 1968, SUZUKI 1980a). Of these, however, only three (two cases in *Phalangium opilio*: BŁASZAK 1968; and one in *Gagrellula ferruginea*: SUZUKI 1980a) seem to be of true "intersex" in the sense that entire body including reproductive system is intermediate between the both sexes<sup>1)</sup>. Likewise, only four cases have been known as the harvestman gynandromorphs (SUZUKI 1980b: all of

1) BLANC (1880) and BŁASZAK (1968) described many male opilionids as "hermaphrodite" or "intersex" for the reason that they carried several pieces of ovarian tissue on their testes. However, it is not reasonable to treat these individuals as the cases of intersexuality in the strict sense, because, according to SUZUKI (1966), this phenomenon is not rare in many opilionid species.

them were found in *Leiobunum globosum*).

I report here on two additional cases of pseudohermaphroditism found in Japanese harvestmen belonging to Gagrellidae; one is an intersex in *Gagrellula montana* and the other is a gynandromorph in *Melanopa grandis*.

Anatomical observation was made on the specimens fixed with 80% ethanol. It was sufficient for the observation on major reproductive systems.

***Gagrellula montana* SATO et SUZUKI (Intersex)**

(Figs. 1-4)

The specimen was collected from a corner of artificially planted Japanese Red Cedar (*Cryptomeria japonica*) forest by the author at Haruyama, near Lake Tazawa, Akita Pref. (250~270 m in altitude) on 25 August 1980. Normal specimens of both sexes (10♂♂, 2♀♀) were simultaneously collected from the same area.

As shown in Figs. 1 and 2, the body length and the total length of Leg I are intermediate between both sexes.

The structure of palpus (Fig. 3-E, F) is generally similar to that of male except for somewhat slender tarsus as in female; the tarsus is furnished with a row of black denticles ventromedially (a secondary male character), but number of such denticles is considerably reduced.

The reproductive system (Fig. 4-C, F) is a mixture of male and female parts as a whole. The gonad is not an ovotestis but a typical ovary in the appearance, though eggs in every follicle were only imperfectly matured. On the other hand, the duct connecting the gonad with the genitalia looks like sperm reservoir and propulsion organ, the latter entering genitalia. No eggs were seen in this duct. It seems that the ovary lacks ability to produce mature eggs, because in the normal female collected at the same time, the ovary was already postmatured and most of mature eggs had been passed into the common oviduct (egg reservoir<sup>1)</sup>) (cf. Fig. 4-B).

Genitalia: in this species, penis of the normal male consists of a slender shaft with a pair of long wings along the both lateral sides, and a glans with

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1) Hitherto, this part has been referred to "uterus (or uterus internus)" for a long time. But, I think that the term "uterus" is inadequate for this part because also in invertebrates this term usually means maternal organs where fertilized eggs or early embryos stay for a while.

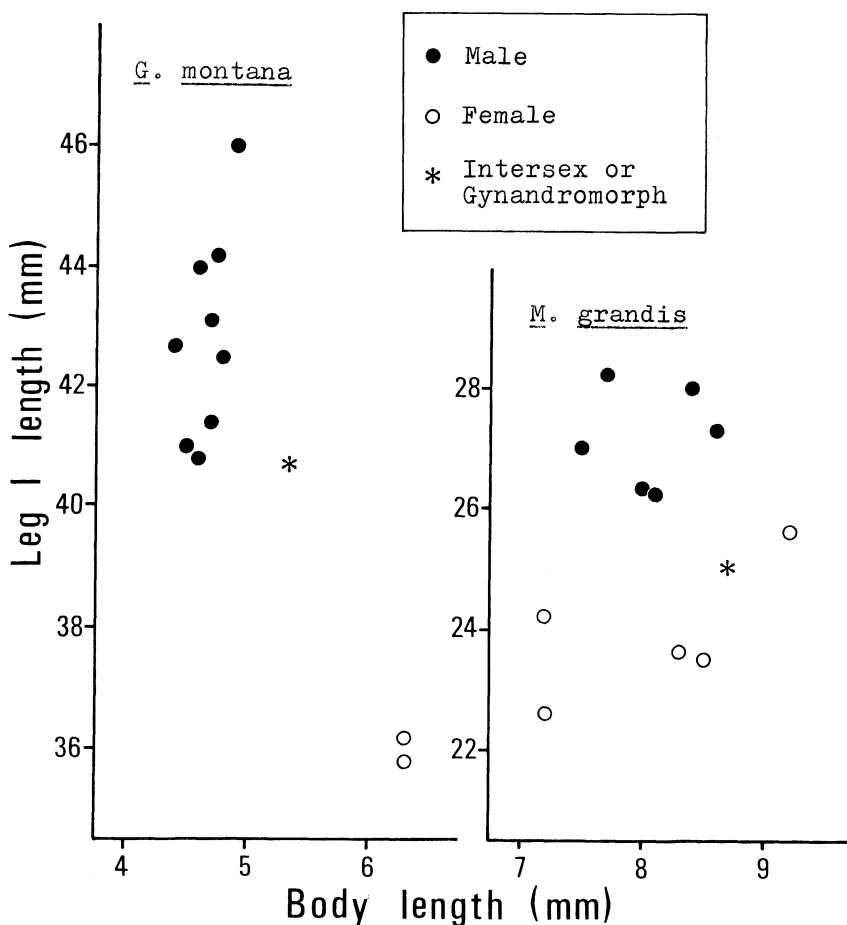


Fig. 1. Relation of total length of leg I to body length in *Gagrellula montana* (Haruyama, L. Tazawa exs.) and *Melanopa grandis* (Tsubaki, Is. Sado exs.).

an ejaculatory stylus on its tip (Fig. 4-D). On the other hand, ovipositor, homologue of the penis, is composed of three forceps segments and about 20 normal segments, of which first eight armed with a whirl of eight spines (Fig. 4-E). Seminal receptacles which located in the third normal segments are as shown in Fig. 4-H. The genital structure of the intersex shows a condition intermediate between both sexes (Fig. 4-F). Namely, it consists of a wide shaft, somewhat sclerous distal portion having an ejaculatory stylus and surrounding several setae, a pair of small wings, and an ejaculatory duct entering through the

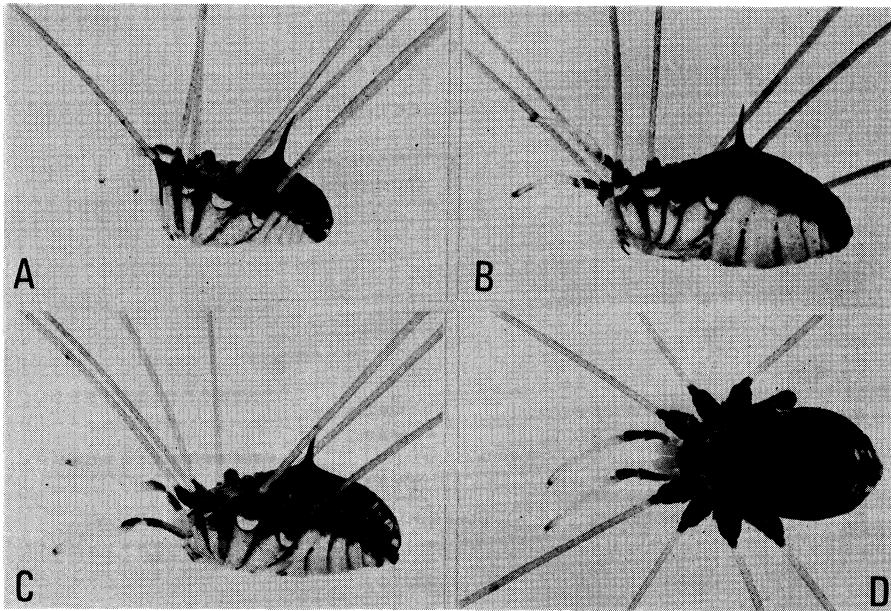


Fig. 2. *Gagrellula montana* SATO et SUZUKI. A: Male, lateral. B: Female, lateral. C, D: Intersex; C, Lateral; D, Dorsal. (Haruyama, L. Tazawa) All  $\times 5$ .

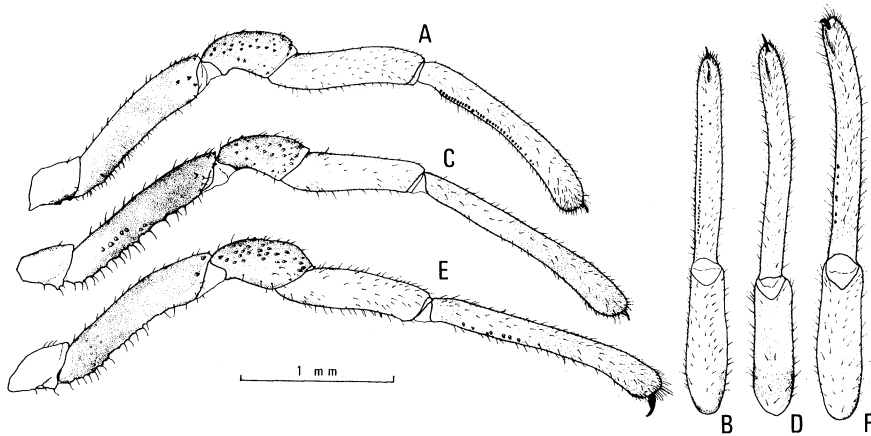


Fig. 3. *Gagrellula montana* SATO et SUZUKI. A, B: Male. C, D: Female. E, F: Intersex. A, C, E: Left palpus, mesal. B, D, F: Tarsus and tibia of left palpus, ventral. (Haruyama)

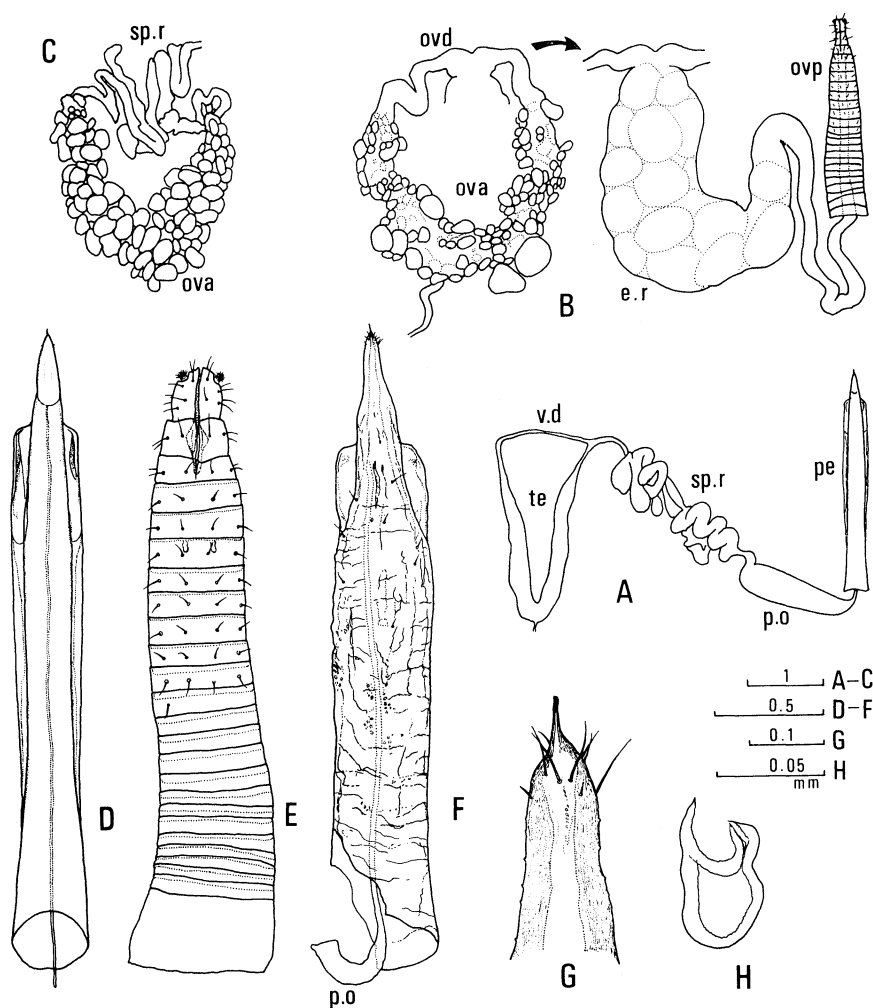


Fig. 4. *Gagrellula montana* SATO et SUZUKI. A-C: Internal reproductive system; A, Male; B, Female; C, Intersex. D-G: Genitalia, ventral; D, penis; E, ovipositor; F, Intersex; G, Enlargement of distal end, intersex. H: Left seminal receptacle of normal female. (Haruyama exs.)—te=testis; v.d=vas deferens; sp.r=sperm reservoir; p.o=propulsion organ; pe=penis; ova=ovary; ovd=oviduct; e.r=egg reservoir; ovp=ovipositor.

shaft. The shaft resembles the ovipositor rather than the penis but lacks any distinct segmentation, though numerous transverse wrinkles and a few sparse spines can be seen. Seminal receptacles and sensilla setose lobes are absent.

Judging from the above comparison, it is almost certain that also this anomalous genital structure is non-functional.

***Melanopa grandis* ROEWER (Gynandromorph)**

(Figs. 1, 5-7)

The specimen was collected together with several normal specimens of both sexes (6♂♂, 5♀♀) from under logs and debris in a small man-made woodland of Japanese Red Cedar by the author at Tsubaki, Ryôtsu-shi, Is. Sado (ca. 20 m in alt.) on 20 July 1980. This is the first record of this species from Is. Sado.

This species is one of the taxonomically problematic opilionids because it shows remarkable geographic diversity. According to SUZUKI (1972), this species can be roughly divided into three principal groups by various characters (e.g. size and proportion of the body and legs, structure of genital operculum in female, etc.). The present specimens from Tsubaki clearly fall under the form which referred as "four-sectioned type" of SUZUKI (1972) with respect to female genital operculum. This form has been so far known from northeastern part

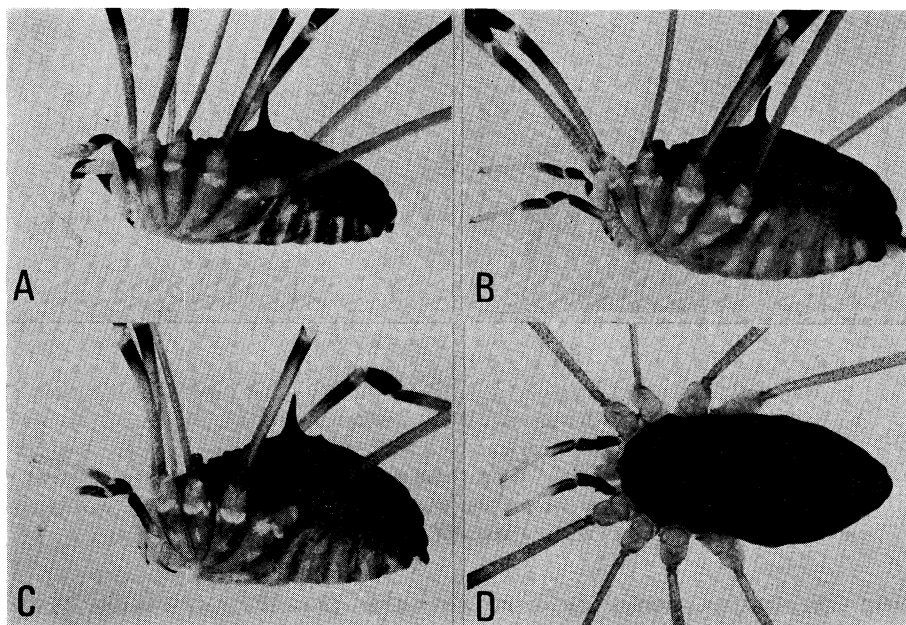


Fig. 5. *Melanopa grandis* ROEWER. A: Male, lateral. B: Female, lateral. C, D: Gynandromorph; C, Lateral; D, Dorsal. (Tsubaki, Is. Sado) All×4.

of Honshu (from Kinki to Tohoku districts).

In this form the secondary sexual character appears in size, palpus, chelicera, and genital operculum (cf. Figs. 1, 5, and 6).

Body size: Fig. 1 right presents the relation between the body length (BL) and the total length of leg I (LIL) in each specimen taken from Tsubaki. Evidently males are larger in LIL than female, while no difference is detected between both sexes in BL. It may have been caused by the immaturity of ovaries in these female specimens (adults seem to emerge in mid-July in this population) (cf. Fig. 7-B). Concerning the LIL value, the gynandromorphic specimen occupies an approximately intermediate position between both sexes.

As shown in Fig. 6-C, F, palpus resembles that of female in general appearance. However, it has a definite row of blackish denticles on ventromesal surface of the tarsus (eight in left palpus and seven in right one). Further, tubercles on the medial side of the femur are not so many as in the female.

Chelicera (Fig. 6-I). Distal segment of chelicera is the same as in normal female, lacking any denticles distomesally.

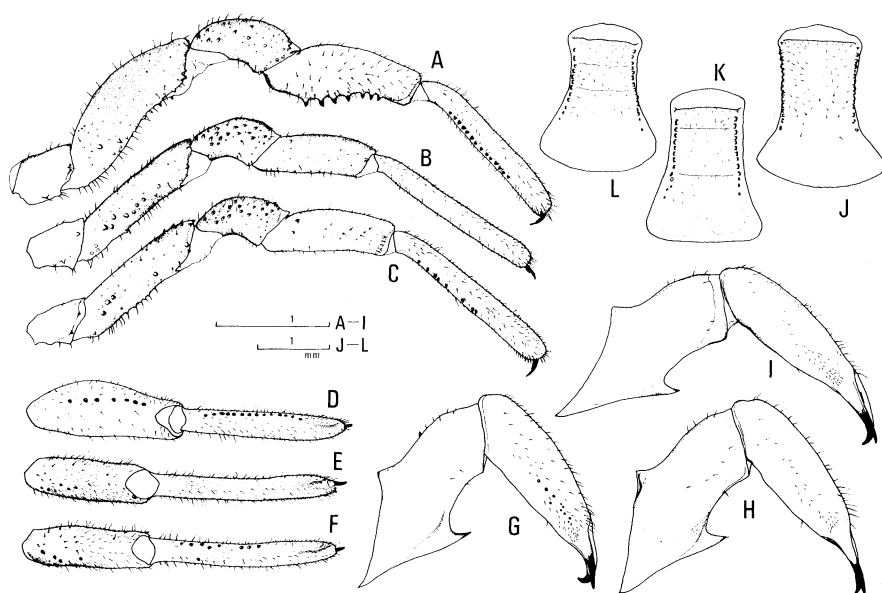


Fig. 6. *Melanopa grandis* ROEWER. A, D, G, J: Male. B, E, H, K: Female. C, F, I, L: Gynandromorph. A-C: Left palpus, mesal. D-F: Tarsus and tibiae of left palpus, ventral. G-I: Chelicera, mesal. J-K: Genital operculum. (Tsubaki)

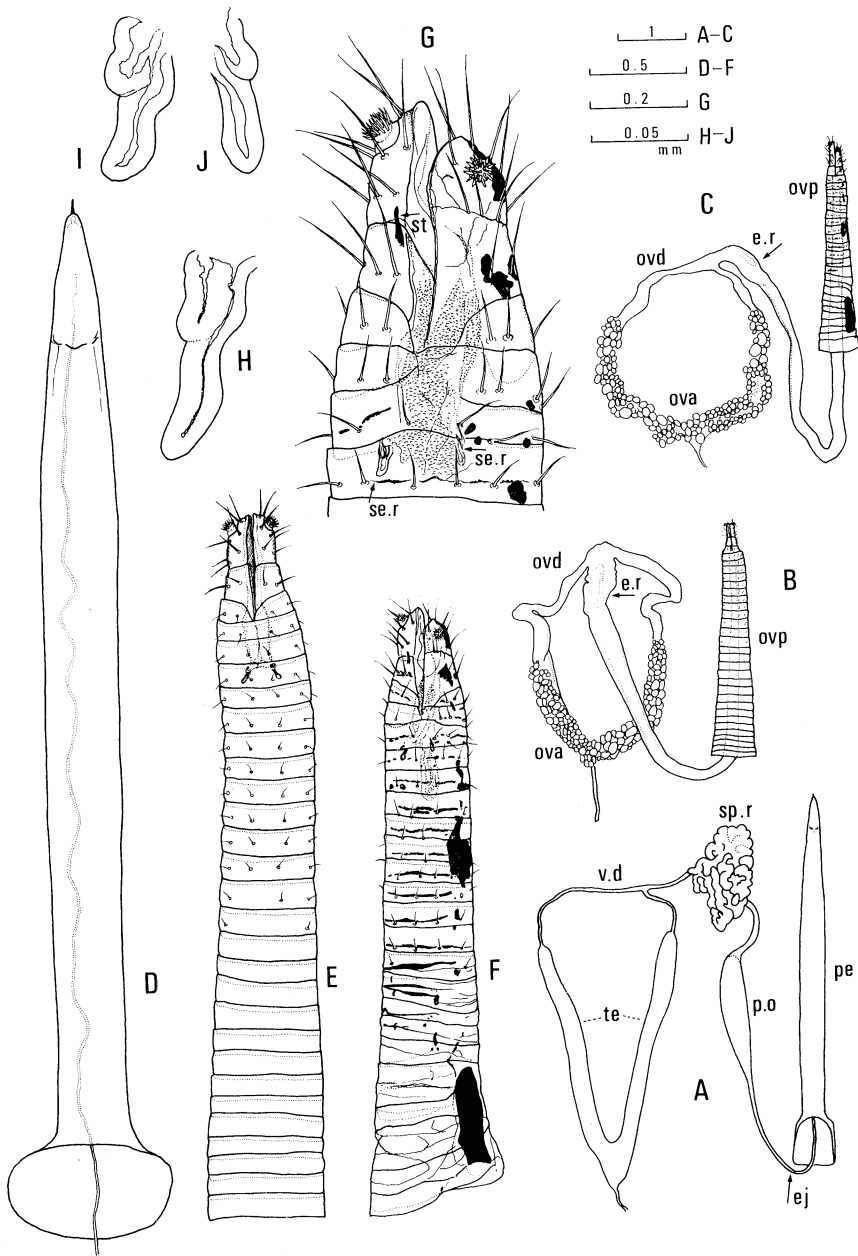


Fig. 7. *Melanopa grandis* ROEWER. A-C. Internal reproductive system: A, Male; B, Female; C, Gynandromorph. D-G: Genitalia, ventral; D, penis; E, ovipositor; F, Gynandromorph, shaded portion shows element of male; G, Enlargement of distal part, gynandromorph. H: Left seminal receptacle of normal female. I, J: Left and right seminal receptacles of gynandromorph. (Tsubaki exs.)—st=stylus; se.r=seminal receptacle; ej=ejaculatory duct. Further explanation of abbreviations are given in Fig. 4.



Genital operculum, also as in the female, consists of an incrassate terminal and a plate, of which three regions are recognizable by the distinct transverse furrows<sup>1)</sup>, but the intermediate region of the plate is smaller than that of normal female.

The reproductive system is of normal female except for the genitalia (compare Fig. 7-B and C). The ovary shows immature state as in normal females. The genitalia form a typical ovipositor in general structure, but haphazardly inlaid with numerous chitinous fragments which seem to be derived from male tissue. A pair of seminal receptacles are present although somewhat small in size (Fig. 7-I, J).

Considering all facts described above, this individual seems to be an irregular gynandromorph with the male tissue occupying only small parts of the body. This individual may have retained reproductive capacity, because reproductive system seems to be relatively normal at least in the appearance.

### Remarks

Very little is known concerning the mechanism of production of intersexes and gynandromorphs in opiliones. SUZUKI (1980b) has suggested that double fertilization of a binucleate egg by X-bearing and Y-bearing spermatozoa could account for gynandromorphs in *Leiobunum globosum*. However, this hypothesis seems to be unlikely for the present gynandromorph in *Melanopa grandis* because male tissue occupied only a few small parts of an individual in this case. An alternative process as that known to occur in *Drosophila* may be account for this case. According to this hypothesis gynandromorph would have occurred from an XX zygote by loss of one of the two X chromosomes at an early cleavage. However, it is premature to speculate further on this subject because we have very poor knowledge on opilionid genetics (even on mechanism of sex determination) as yet.

By the way, if we assume some recessive genes responsible for the production of gynandromorph or intersex, enforced inbreeding resulted from low vagility, which is a characteristic nature in almost all opilionid species, would lead to high frequency of gynandromorphs or intersexes in these animals. The fact that either of present two cases were collected from more or less isolated small

1) Among five normal females examined, one specimen had a plate consisting of only two regions owing to disappearance of a distal furrow.

patch of Japanese Red Cedar woodland may support this assumption. Although hitherto no more than nine individuals have been described as the cases of intersexuality or gynandromorphism in Opiliones, it seems to me that this number is not so small for these inconspicuous and relatively unpopular animals. Further attention on these phenomena in Opiliones would be highly expected.

### Acknowledgments

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### 摘 要

鶴崎展巨 (北海道大学理学部動物学教室, 〒060 札幌市北区北10条西8丁目): フンザトウムシ類の間性と雌雄モザイク。

1980年8月, 秋田県田沢湖春山において採集された キタアカサビザトウムシ *Gagrellula montana* SATO et SUZUKI の間性1例, および同年7月, 新潟県佐渡両津市椿において採集されたオナガザトウムシ *Melanopa grandis* ROEWER の雌雄モザイク1例を報告した。

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